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In re application of: Okubo et al.

Application No. 10/635,803

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For: RETICLE-HOLDING PODS AND METHODS FOR HOLDING THIN, CIRCULAR RETICLES, AND RETICLE-HANDLING SYSTEMS UTILIZING SAME

Examiner: Not yet assigned

Art Unit: 3652

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CERTIFICATION

I certify that the attached English translation is a true and literal translation of the corresponding Japanese patent application no. 2002-226926.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Date: 7/16/04 Fumiyo S Bennett

STATE OF Oregon)
) ss.
COUNTY OF Multnomah)

This 16th day of July, 2004, before me personally came the above-named Fumiyo S. Bennett, who executed the foregoing instrument in my presence, and who acknowledged to me that he executed the same of his own free will for the purposes set forth therein.

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[SEAL]

Deborah J Leo
Notary Public for Oregon
My commission expires: 3/8/08

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GM division

M Supervisor

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Development and Intellectual Property Center

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$ Nikon Corporation

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Title of Invention: Reticle Holding Method, Reticle Holding Apparatus and Exposure Apparatus

[Claims]

Claim 1 A reticle holding method characterized in that it is a method that holds a reticle in which a pattern has been formed on a circular substrate,

and it supports from below points (holding points) at three locations of the outer edge of said reticle substrate that are approximately equally separated while elastically imparting energy downward to and pressing against soft, non-adhesive presser members from directly above said holding points to hold down said holding points.

Claim 2 A reticle holding apparatus characterized in that it is equipped with

support members that support from below points (holding points) at three locations of the outer edge of a circular reticle substrate that are approximately equally separated,

a base member to which said support members are secured,

a cover that covers the upper surface of said reticle substrate, and

soft, non-adhesive pressure application members that elastically impart energy from directly above the holding points of said reticle substrate to hold down said holding points.

Claim 3 A reticle holding apparatus described in Claim 2; characterized in that said pressure application members consist of flat springs, rubber rings or rubber blocks attached to the end portions thereof, or resin blocks.

Claim 4 A reticle holding apparatus characterized in that it is equipped support members that support from below points (holding points) at three locations of the outer edge of a circular reticle substrate that are approximately equally separated,

a base member to which said support members are secured, and

a cover that covers the upper surface of said reticle substrate, and

notch engagement protrusions that engage with the notches of said reticle substrate are provided on said support members.

Claim 5 A reticle holding apparatus described in any one of Claims 2, 3 or 4; characterized in that stopper pins for preventing positional misalignment of said reticle substrate are provided on said support members.

Claim 6 A reticle holding apparatus characterized in that it is equipped support members that support from below points (holding points) at three locations of the outer edge of a circular reticle substrate that are approximately equally separated,

a ring-shaped member to which said support members are secured,

a base member to which said ring-shaped member is secured, and

a cover that covers the upper surface of said reticle substrate, and

positioning mechanisms are provided between said ring-shaped member and said base member.

Claim 7 An exposure apparatus that transfers exposes the pattern on a reticle onto a sensitive substrate; characterized in that it is equipped with a reticle holding apparatus described in any one of Claims 2 ~ 6 as the storage apparatus of said reticle.

[Detailed Explanation of the Invention]

[0001] [Technical Field of the Invention]

The present invention relates to a reticle holding method and apparatus used in semiconductor manufacturing apparatuses and exposure apparatuses. It particularly relates to a reticle holding apparatus and method, etc. that improved reticle holding apparatuses (reticle pods) that have a record of conventional usage to enable holding of circular reticles such as those for EB exposure.

[0002] [Prior Art]

Commercially available reticle holding apparatuses (reticle pods) are mostly applicable to square (the length of one side is, as one example, 152.4 mm (6 inches)) reticles made of glass with a thickness of several mm. Those called SMIF (Standard Mechanical Interface) system pods are the most commonly known reticle holding apparatuses.

[0003] FIG. 10 is plan view that shows the structure of a conventional single-unit reticle holding apparatus.

As shown in FIG. 10, this SMIF system reticle holding apparatus (reticle pod) 80 is such that the planar shape is square, and it consists mainly of a base 81 and a cover 83. The cover 83 is secured in an airtight manner by a fixing mechanism that is not shown in the drawing, and the space between the upper surface of the base 81 and the cover 83 is sealed.

[0004] Receiving members 85 are arranged at the four corners of the upper surface of the base 81. The receiving members 85 are such that the planar shape is oval, and they are

arranged to face the center of the base 81. The four corners of the square reticle R are placed at the end portions of the insides of these receiving members 85. Also, the four corners of the reticle R are pushed against the receiving members 85 to secure the reticle R by means of presser members (not shown in the drawing) provided at the inner surface of the cover 83. Filters 87 are provided at two corners on a diagonal on the upper surface of the base 81. This filter 87 is for removing airborne debris that enters the pod.

[0005] This type of reticle pod 80 is such that the held reticle R can be held within a closed space, so it is possible to prevent debris adhering to the reticle R. In addition, an opener for opening the cover 83 that is specially designed for this pod is also commercially available, so ease of use is good.

[0006] [Problems To Be Solved by the Invention]

In recent years, development of exposure apparatuses that use electron beams (EB) as exposure apparatuses that combine higher resolution and higher throughput is being

pursued. In these EB exposure apparatuses, a conventional glass square reticle is not used; a round, thin reticle that has the same shape as a SEMI standard wafer or SEMI standard notch wafer is used. A thickness of this reticle of approximately 0.5 mm ~ 1 mm and a diameter of eight inches would be considered strong. The pattern is formed on almost the entire surface of this reticle for EB exposure. An EB is irradiated to the upper surface of this pattern to pass through from the pattern aperture, so the upper and lower surfaces of the pattern cannot come into contact. For this reason, the portions that can come into contact are only the upper and lower surfaces of portions of the outer edge with widths of several mm that are portions other than those of the pattern, and it is necessary to hold the reticle at these portions.

[0007] Here, the commercially available reticle pod 80 shown in FIG. 10 has been created for a square reticle. For this reason, in this status, it is not possible to hold reticles whose shape is round and in which the holdable portion has a width of the outer edge that is only a portion that is

several mm as in the case a reticle for EB exposure.

[0008] The present invention takes the aforementioned problems into account, and its purpose is to provide a reticle holding apparatus, etc. that is appropriate for reticles for EB exposure. In particular, its purpose is to provide a reticle holding apparatus, etc. that improves commercially available reticle holding apparatuses (reticle pods) to enable use with reticles for EB exposure.

[0009] [Means To Solve Problems]

In order to solve the aforementioned problems, the reticle holding method of the present invention is characterized in that it is a method that holds a reticle in which a pattern has been formed on a circular substrate, and it supports from below points (holding points) at three locations of the outer edge of the aforementioned reticle substrate that are approximately equally separated while elastically imparting energy downward to and pressing against soft, non-adhesive presser members from directly above the aforementioned holding points to hold down the aforementioned holding points.

[0010] The first reticle holding apparatus of the present invention is characterized in that it is equipped with support members that support from below points (holding points) at three locations of the outer edge of a circular reticle substrate that are approximately equally separated, a base member to which the aforementioned support members are secured, a cover that covers the upper surface of the aforementioned reticle substrate, and soft, non-adhesive pressure application members that elastically impart energy from directly above the holding points of the aforementioned reticle substrate to hold down the aforementioned holding points.

[0011] By supporting the outer edge of a reticle for EB exposure that has the same shape as a SEMI standard wafer from the upper and lower directions at three locations, it is possible to stably hold this reticle. Moreover, by creating the presser members that hold down the outer edge of the reticle from soft, non-adhesive materials, it is possible to prevent the surface of the reticle from being damaged.

In addition, since it is possible to manufacture improved commercially available SMIF system reticle pods, it is possible to use cover openers that correspond to these commercially available reticle pods.

[0012] In the present invention, it is preferable that the aforementioned pressure application members consist of flat springs, rubber rings or rubber blocks attached to the end portions thereof, or resin blocks. By using rubber rings or rubber blocks, or resin blocks as the presser members, it is possible to prevent the reticle surface from being damaged. In addition, by using flat springs to impart energy to the presser members, large loads are prevented from being applied to the reticle, and it is possible to prevent bending and warping of thin reticles.

[0013] The second reticle holding apparatus of the present invention is characterized in that it is equipped support members that support from below points (holding points) at three locations of the outer edge of a circular reticle substrate that are approximately equally separated, a base member to which the aforementioned support members are

secured, and a cover that covers the upper surface of the aforementioned reticle substrate, and notch engagement protrusions that engage with the notches of the aforementioned reticle substrate are provided on the aforementioned support members.

By providing notch engagement protrusions, it is possible to handle reticles with the same shape as SEMI standard notch wafers, and it is possible to smoothly perform positioning of the reticle.

[0014] In the present invention, it is preferable that stopper pins for preventing positional misalignment of the aforementioned reticle substrate be provided on the aforementioned support members. It is possible to easily perform positioning when mounting the reticle in the reticle holding apparatus.

[0015] The third reticle holding apparatus of the present invention is characterized in that it is equipped support members that support from below points (holding points) at three locations of the outer edge of a circular reticle substrate that are approximately equally separated, a ring-

shaped member to which the aforementioned support members are secured, a base member to which the aforementioned ring-shaped member is secured, and

a cover that covers the upper surface of the aforementioned reticle substrate, and positioning mechanisms are provided between the aforementioned ring-shaped member and the aforementioned base member.

Since a ring-shaped member (new member) is positioned on the base member (existing part) when improving commercially available SMIF system reticle pods, it is possible to fix the relative positional relationship of the base member and the reticle to be mounted on the support members on the ring-shaped member.

[0016] The exposure apparatus of the present invention is an exposure apparatus that transfers exposes the pattern on a reticle onto a sensitive substrate; characterized in that it is equipped with any of the reticle holding apparatuses described above as the storage apparatus of aforementioned reticle.

In EB exposure apparatuses in particular, it is possible to hold the reticle in a commercially available reticle pod. In addition, it is also possible to use cover openers that correspond to these reticle pods, so ease of use is improved,

[0017] [Embodiments of the Invention]

An explanation will be given below while referring to drawings.

FIG. 1 is a plan view that shows the structure of a reticle holding apparatus relating to an embodiment of the present invention.

FIG. 2 is a plan view that shows the structure of the base of the reticle holding apparatus of FIG. 1.

FIG. 3 is a drawing that shows an enlargement of a portion of the base.

FIG. 4(A) is an A-A cross-sectional view of the reticle holding apparatus of FIG. 1, and FIG. (B) is a drawing that shows an enlargement of a portion of FIG. 4(A).

FIG. 5 is a B-B cross-sectional view of the reticle holding apparatus of FIG. 1.

[0018] This reticle holding apparatus 1 has added improvements to the conventional SMIF system reticle pod 80 shown in FIG. 10. This holding apparatus 1 has a pod base (base member) 3 and a pod cover (cover) 5. In the same way as the reticle pod 80 of FIG. 10, the pod cover 5 is secured to the pod base 3 in an airtight manner by means of a fixing mechanism that is not shown in the drawing, and the space between the upper surface of the pod base 3 and the pod cover 5 is sealed.

[0019] Three pressure application members 7-1 ~ 3 for reticle pressure application are provided on the pod cover 5. In addition, three table blocks (support members) 19-1 ~ 3 are provided on the pod base 3. The reticle R is supported between these pressure application members 7 and table blocks 19 (to be discussed in detail later).

[0020]

First, the structure of the pod base 3 will be explained.

As shown in FIG. 2, in the same way as the conventional SMIF system reticle pod base, blocks (receiving members) 11

are arranged at the four corners of the upper surface of the pod base 3. The blocks 11 are such that the planar shape is oval, and they are arranged to face the center of the pod base 3. Filters 13 for removing airborne debris that enters the pod are provided at two corners on a diagonal on the upper surface of the pod base.

[0021] A toroidal ring-shaped member 15 is arranged on the upper surfaces of the inside ends of the blocks 11 and secured to the blocks 11 by machine screws 17. The method of positioning the blocks 11 and the ring-shaped member 15 will be discussed later. As shown in FIG. 4, the ring-shaped member 15 consists of an inner ring-shaped portion 15a that is tall in height and an outer ring-shaped portion 15b that is short in height. Table blocks (support members) 19-1 ~ 3 are secured by machine screws 21 to three locations on this outer-ring shaped portion 15b. The respective table blocks 19 are arranged at nearly equal angles with respect to the center point of the ring-shaped member 15. In addition, none of the table blocks 19 are arranged on the center line L (shown in FIG. 1) in the

horizontal direction of the pod base 3. This will be discussed in detail later based on its relationship with the pod opener.

[0022] As shown in FIG. 4 and FIG. 5, the table blocks 19 consist of a flat square base portion 19a and a mounting portion 19b that stands up along the edge of the inner side of that base portion 19a. The base portion 19a is mounted on the outer ring-shaped portion 15b of the ring-shaped member 15. In addition, the walls of the inner sides of the table blocks 19 are arranged along the circumferential direction of the ring-shaped member 15 so that they come into contact with the walls of the outer side of the inner ring-shaped portion 15a of the ring-shaped member 15, and the base portion 19a are secured on the outer ring-shaped portion 15b by two machine screws 21. The upper surfaces 19c of the mounting portions 19b of the respective table blocks 19 are equal in height and flat. These upper surfaces 19c are the reticle mounting surfaces on which the reticle R is mounted. As shown in FIG. 5, a taper 19d is provided at the inner edge of the mounting portion upper

surface 19c.

[0023] As shown in FIG. 2, the shape varies among table block 19-1 and table blocks 19-2 and -3. As shown in FIG. 5, table blocks 19-2 and -3 are such that a stopper pin 23 is secured to the outside of the mounting portion upper surface 19c. On the other hand, as shown in FIG. 3, table block 19-1 is such that a notch engagement portion 24 is formed on the mounting portion surface 19c. This notch engagement portion 24 has a protrusion portion 24a that extends in the inside direction. The protrusion portion 24a engages with the notch N of the reticle R in the case in which the reticle R is a notch wafer, and it is possible to perform positioning of the reticle R.

The stopper pins 21 and the notch engagement portions 24 of the respective table blocks 19 are arranged at the outer edge of the reticle R that is held by this reticle holding apparatus 1.

[0024] Next, the structure of the pod cover 5 will be explained.

As shown in FIG. 1, the three pressure application members 7 are attached to the inner side of the upper surface of the pod cover 5. In this example, the pressure application members 7 are such that they can be attached in two locations along the left side of the upper surface of the cover 5 and two locations along the right side that opposes this side, for a total of four locations. As shown in FIG. 4, the portions of the cover 5 to which the pressure application members 7 are attached are thick. In addition, screw holes 27 are formed in these thick portions (pressure application member attachment portions 25).

[0025] As shown in FIG. 4, the pressure application members 7 consist of a base portion 29, a flat spring 31 that extends from this base portion 29, and a presser member 33 attached to the front end of this flat spring 31. The base portion 29 is secured to the lower surface of the pressure application member attachment portion 25 of the cover 5 by a screw 35 that passes through a screw hole 27 from above this portion. An O-ring 37 is interposed between the upper surface of the base portion 29 and the lower surface of the

pressure application member attachment portion 25, and it prevents debris from entering from the gap of the machines screw 35 and the screw hole 27.

[0026] A flat spring 31 extends from this base portion 29. As shown in FIG. 1, the flat spring 31 has a thin, long triangular shape consisting of a short side and two long sides. In addition, the short side is secured to the base portion 29, and the front end that is the intersection of the two long sides extends in the inside direction of the cover 3. A presser member 33 is attached to the front end. As shown in detail in FIG. 4(B), the presser member 33 consists of an O-ring 39 and a small screw 41. A nearly semicircular groove 45 is formed at the outer circumference surface of the head 43 of the small screw 41. The O-ring 39 is inserted into this groove 45. The O-ring 39 is made of a clean material with little adhesion. The screw portion 47 of the small screw 41 is screwed into the front end of the flat spring 31. A driver insertion groove 49 is formed on one side of the head 43. In one example, the outer diameter of the O-ring 39 is approximately 6.1 mm, and the inner

diameter is approximately 2.6 mm.

[0027] In this example, the pressure application members 7 are attached to pressure application member attachment portions 25 at the three locations of the upper left, lower left and upper right of FIG. 1.

[0028] As shown in FIG. 1, the flat springs 31 of the respective pressure application members 7 are such that the lengths of the short sides are equal, but the lengths of the long sides are different, and they are all different shapes. For example, flat spring 31-2 of pressure application member 7-2 of the lower left of the FIG. 1 is the longest, and the one with the shortest length is flat spring 31-3 of pressure application member 7-3 of the upper right. Here, the length is considered to be the length from the flat spring fixing portion (pressure application member attachment portion 25 of the cover to which the base portion 29 of the pressure application member 7 is secured) to the front end. The lengths of the respective flat springs are selected to extend from the pressure application member attachment portions 25 of the cover to

nearly the center of the mounting portion upper surfaces 19c of the respective table blocks 19 fixed on the pod base 3. Also, even in the case in which the shape of the flat spring 31 differs in this way, the thickness is selected so that the forces (1N, for example) that the O-ring 39 imparts downward become equal.

Note that pressure application member attachment portions 25 are provided on the cover 3 in four places, and any three locations can be selected.

[0029] Through this type of structure, the O-rings 39 of the front ends of the flat springs 31 of the pressure application members 7 are positioned directly above the mounting portion upper surfaces 19c (reticle mounting surfaces) of the respective table blocks 19. In addition, this O-ring 39 imparts energy in the direction directly below toward the mounting portion upper surface 19c by means of the flat spring 31.

[0030] Next, the method of using this reticle holding apparatus 1 will be explained.

First, the pod cover 5 is opened, and the reticle R is mounted on the mounting portion upper surfaces 19c of the table blocks 19 secured to the ring-shaped member 15 on the pod base 3. At this time, the notch N of the reticle R is positioned so that it is located at table block 19-1 to which notch engagement portion 24 is attached. Through this, it is possible to fix the position of the reticle R within the reticle holding apparatus 1. Since the table blocks 19 are arranged on a torus, the mounting portion upper surface 19c is connected to the outer edge of the reticle R for EB, and it is not connected to the pattern surface. At this time, since stopper pins 23 are provided on the mounting portion upper surfaces 19c of the other two table blocks 19-2, -3, it is [possible] to prevent positional misalignment of the reticle R in the horizontal directions.

[0031] After the reticle R has been positioned on the mounting portion upper surfaces 19c, the cover 5 is put on. At this time, the O-ring 39 of the pressure application member 33 comes into contact [nearly at points] with the upper

surface of the outer edge of the reticle R that is mounted on the mounting portion upper surfaces 19c. Also, since the O-ring 39 imparts energy directly below by means of a flat spring 31, the outer edge of the reticle R is sandwiched between the mounting portion upper surfaces 19c and the O-ring 39. The O-ring 39 has elasticity, so the surface of the reticle R will not be damaged. Moreover, the O-ring 39 imparts energy in the direction directly below at an appropriate strength by means of the flat spring 31, so large loads are prevented from being applied to and bending the reticle R. After the reticle R is supported between the pod base 3 and the cover 5 in this way, both are secured in an airtight manner by means of a fixing mechanism.

[0032] Note that when the removing the reticle R from this apparatus 1, when the cover 5 is opened, the pressure application members 7 are simultaneously separated from the pod base 3, and the O-ring 39 is separated from the reticle surface. At this time, the adhesiveness of the O-ring 39 is weak, so the reticle R does not stick to the O-ring 39, and it is not separated along with the cover 3.

Also, in the case where the O-ring 39 has become worn, the O-ring 39 is rotated along the head 43 of the small screw 41, and a new surface is brought into contact with the reticle R. In addition, if the wear has become severe and has caused damage, it is possible to remove it from the small screw 41 and replace it.

[0033] In addition, it is also possible to open this reticle holding apparatus 1 using a commercially available opener. This opener is usually equipped with a sensor that detects the presence or absence of a reticle R within the reticle holding apparatus 1. The optical axis of this detection sensor is above the center line L (see FIG. 1) in the horizontal direction of this holding apparatus. Therefore, in this holding apparatus 1, in the aforementioned way, it is possible to arrange all of the mounting portions 19b of the table blocks 19 at positions that are separated from the optical axis of the sensor. For this reason, sensor light is not interfered with, and functioning of the sensor is not prevented. Note that it is preferable that the angle θ made by the center point of the pod base 3, the line L1

that passes through the center of the mounting portion 19b of the table block, and the horizontal center line L of the reticle pod be 5° or more.

[0034] Next, the method of positioning the blocks 11 and the ring-shaped member 15 will be explained. In the aforementioned way, the reticle holding apparatus 1 of this example uses a commercially available reticle pod, and a ring-shaped member 15 is attached to the pod base 3 of this reticle pod. At this time, the ring-shaped member 15 is positioned using a positioning jig so that it comes to the appropriate position on the pod base 3.

[0035] FIG. 6 is a drawing that explains a positioning operation resulting from the positioning jig.

The positioning jig 60 has a pedestal 61 on which the pod base 3 is placed, positioning pins 63 arranged in a standing manner on this pedestal 61, and a positioning arm 65. The positioning pins 61 [sic; 63] position the pod base 3 on the pedestal 61. The positioning arm 65 positions the ring-shaped member 15 on the pod base 3.

[0036] First, the pod base 3 is placed on the pedestal 61 and positioned with the positioning pins 63. Next, the ring-shaped base 15 is placed on the pod base 3 and is positioned with the positioning arm 65. Through this, the ring-shaped member 15 is positioned at the appropriate position on the pod base 3, and the relative positional relationship of the pod base 3 and the ring-shaped member 15 is maintained. After both have been positioned, the outer ring-shaped portion 15b of the ring-shaped member 15 is secured to the blocks 11 on the pod base 3 by means of machine screws 17.

[0037] FIG. 7 is a side view that shows another example of the structure of the pressure application member.

The presser 33' in this example is formed by a ring-shaped block 71 made of resin and a screw 73. A screw 73 that extends in the horizontal direction is formed on one side surface of the ring-shaped resin block 71, and a driver insertion groove 75 is formed at the other side surface. The outer edge 71a of the ring-shaped resin block 71 is semicircular. The ring-shaped block 71 and the screw

73 may also be manufactured as a unit. In addition, the ring-shaped block 71 may be made of rubber.

[0038] FIG. 8 is a plan view that shows the structure of a reticle holding apparatus relating to another embodiment of the present invention.

The reticle holding apparatus of this example has a structure that is nearly the same as the reticle holding apparatus of FIG. 1, but the structure of the pod base is different. Note that parts that have a structure and operation that are the same as those of the respective parts of the reticle holding apparatus of FIG. 1 are assigned the same codes, and explanations thereof have been omitted.

The table blocks 19 on the pod base 3' of this reticle holding apparatus consist of all of the same shapes. That is, in the same way as table blocks 19-2 and 19-3 of reticle holding apparatus 1 in FIG. 1, the table blocks 19 consist of a square base portion 19a and a mounting portion 19b that stands up from this base portion 19a, and a notch engagement portion is not formed.

[0039] According to the configuration of the exposure apparatus, there are cases in which there would be no problem no matter what direction the reticle is in inside the reticle holding apparatus. In such cases, the reticle holding apparatus of this example can be used.

[0040] FIG. 9 is a drawing for schematically explaining the configuration of the exposure apparatus relating to an embodiment of the present invention.

An optical lens barrel 101 is arranged at the upper portion of the electron beam exposure apparatus 100. A vacuum pump (not shown in the drawing) is connected to the optical lens barrel 101, and it evacuates the interior of the optical lens barrel 101.

[0041] An electron gun 103 is arranged at the upper portion of the optical lens barrel 101, and it emits an electron beam downward. An illumination optical system 104 that includes a condenser lens 104a, an electron beam deflector 104b, etc. in order is arranged below the electron gun 103. A reticle R is arranged below this lens barrel 104.

The electron beam emitted from the electron gun 103 is condensed by the condenser lens 104a. Then, sequential scanning is performed in the horizontal direction in the drawing by means of the deflector 104b, and illumination of the respective small regions (subfields) of the reticle R in the visual field of the optical system is performed. Note that the condenser lens 104a is one stage in the drawing, but the actual illumination optical system has several stages of lenses, a beam formation aperture, a blanking aperture, etc.

[0042] The reticle R is secured by electrostatic suction, etc. to a chuck 110 provided on the upper portion of the reticle stage 111. The reticle stage 111 is mounted on a table 116. The reticle R is held and accommodated by the reticle holding apparatus 1 in a reticle accommodation chamber 102 provided on the optical lens barrel 101. In addition, when the reticle is used, the cover 5 is opened by the opener, and transport from the holding apparatus 1 onto the reticle stage 111 is performed by a substrate loader (not shown in the drawing).

[0043] The drive apparatus 112 shown at the left side of the figure is connected to the reticle stage 111. Note that, in actuality, the drive apparatus (linear motor) 112 is incorporated into a stage 111. The drive apparatus 112 is connected to a control apparatus 115 via a driver 114. In addition, a laser interferometer 113 is installed at side (the right side of the drawing) of the reticle stage 111. The laser interferometer 113 is also connected to the control apparatus 115. Accurate reticle stage 111 position information measured by the laser interferometer 113 is input to the control apparatus 115. A command is transmitted from the control apparatus 115 to the driver 114, and the drive apparatus 112 is driven so that the position of the reticle stage 111 becomes the target position. As a result, accurate real time feedback control of the position of the reticle stage 111 is possible.

[0044] A wafer chamber 121 (vacuum chamber) is arranged below the table 116. A vacuum pump (not shown in the drawing) is connected to the side (right side in the drawing) of the wafer chamber 121, and it evacuates the interior of the

wafer chamber 121.

A projection optical system 124 that includes a condenser lens (projection lens) 124a, a deflector 124b, etc. is arranged within the wafer chamber 121 (actually, within the optical lens barrel within the chamber). A wafer (sensitive substrate) W is arranged at the lower portion within the wafer chamber 121.

[0045] The electron beam that has passed through the reticle R is condensed by the condenser lens 124a. The electron beam that has passed through the condenser lens 124a is deflected by the deflector 124b, and the image of the reticle R is resolved at a prescribed position on the wafer W. Note that the condenser lens 124a is one stage in the drawing, but, in actuality, a plurality of stages of lenses, aberration correction lenses, and coils are provided in the projection optical system.

[0046] The wafer W is secured to a chuck 130 provided at the upper portion of the wafer stage 131 by electrostatic chucking, etc. The wafer stage 131 is mounted on a table 136.

The drive apparatus 132 shown on the left side of the drawing is connected to the wafer stage 131. The drive apparatus 132 is actually incorporated into the stage 131. The drive apparatus 132 is connected to a control apparatus 115 via a driver 134. In addition, in actuality, the laser interferometer 133 is installed at the side of the wafer stage 131 (the right side in the drawing). The laser interferometer 133 is also connected to the control apparatus 115. Accurate wafer stage 131 position information measured by the laser interferometer 133 is input to the control apparatus 115. A command is transmitted from the control apparatus 115 to the driver 134, and the drive apparatus 132 is driven so that the position of the wafer stage 131 comes to the target position. As a result, accurate real time feedback control of the position of the wafer stage 131 is possible.

[0047] [Effects of the Invention]

As is clear from the above explanation, through the present invention, it is possible to provide a reticle holding apparatus and method that stably hold reticles for

EB exposure. In particular, the commercially available reticle pod can be improved and manufactured, so it is low in cost. In addition, since it is possible to use a commercially available cover opener that corresponds to this commercially available reticle pod, ease of use is good.

[Brief Explanation of the Drawings]

FIG. 1 FIG. 1 is a plan view that shows the structure of a reticle holding apparatus relating to an embodiment of the present invention.

FIG. 2 FIG. 2 is a plan view that shows the structure of the base of the reticle holding apparatus of FIG. 1.

FIG. 3 FIG. 3 is a drawing that shows an enlargement of a portion of the base.

FIG. 4 FIG. 4(A) is an A-A cross-sectional view of the reticle holding apparatus of FIG. 1, and FIG. (B) is a drawing that shows an enlargement of a portion of FIG. 4(A).

FIG. 5 FIG. 5 is a B-B cross-sectional view of the reticle holding apparatus of FIG. 1.

FIG. 6 FIG. 6 is a drawing that explains a positioning operation resulting from the positioning jig.

FIG. 7 FIG. 7 is a side view that shows another example of the structure of the pressure application member.

FIG. 8 FIG. 8 is a plan view that shows the structure of a reticle holding apparatus relating to another embodiment of the present invention.

FIG. 9 FIG. 9 is a drawing for schematically explaining the configuration of the exposure apparatus relating to an embodiment of the present invention.

FIG. 10 FIG. 10 is plan view that shows the structure of a conventional single-unit reticle holding apparatus.

[Explanation of Codes]

1 Reticle holding apparatus

3 Pod base (base member)

5 Pod cover (cover)

7 Pressure application member

19 Table block (support member)

11 Block (receiving member)

13 Filter

15 Ring-shaped member

17 Machine screw

19 Table block (support member)

21 Machine screw

23 Stopper pin

24 Notch engagement portion

25 Pressure application member attachment portion

27 Screw hole

29 Base portion

31 Flat spring

33 Presser member

35 Screw

37 O-ring

39 O-ring

41 Small screw

43 Head

45 Groove

47 Screw portion

49 Driver insertion groove

60 Positioning jig

61	Pedestal
63	Positioning pin
65	Positioning arm
100	Electron beam exposure apparatus
101	Optical lens barrel
102	Reticle accommodation chamber
103	Electron gun
104	Illumination optical system
110	Chuck
111	Reticle stage
116	Table
112	Drive apparatus
113	Laser interferometer
114	Driver
115	Control apparatus
121	Wafer chamber (vacuum chamber)
124	Projection optical system
130	Chuck
131	Wafer stage
132	Drive apparatus

133 Laser interferometer

134 Driver

136 Table

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FIG. 1

FIG. 2

FIG. 3

FIG. 4

FIG. 5

FIG. 6

FIG. 7

FIG. 8

FIG. 9

102 Reticle accommodation chamber

112 Drive apparatus

113 Laser interferometer

132 Drive apparatus

133 Laser interferometer

134 Driver

114 Driver

115 Control apparatus

FIG. 10

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[Summary]

[Issue]

To provide a reticle holding apparatus, etc. that improves commercially available reticle holding apparatuses (reticle pods) to enable use with reticles for EB exposure.

[Resolution Means]

A reticle holding apparatus 1 is equipped with a pod base 3 and a pod cover 5. Secured onto the pod base 3 are table blocks 19 that support from below points at three locations (holding points) of the outer edge of a circular reticle substrate R that are approximately equally separated. Provided on the cover 5 are soft, non-adhesive pressure application members 31 that elastically impart energy so that the holding points are held down from directly above the holding points of the reticle substrate

R. By supporting the outer edge of a reticle for EB exposure that has the same shape as a SEMI standard wafer from the upper and lower directions at three locations, it is possible to stably hold this reticle.

Selected Figure: FIG. 1

* * *